

SEQUENCE LISTING

<110> Yamamoto, Hiroaki

<120> METHOD FOR PRODUCING OPTICALLY ACTIVE 4-HALO-3-HYDROXYBUTYRIC ACID ESTER

<130> 06501/030001

<150> JP 1998-126507

<151> 1998-10-21

<150> JP 1998-300178

<151> 1998-10-21

<160> 18

<170> FastSEQ for Windows Version 3.0

<210> 1

<211> 244

<212> PRT

<213> Escherichia coli

<400> 1

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Ile Gly Thr Ala Thr Ser Glu Asn Gly Ala Gln Ala Ile Ser Asp Tyr
      35      40      45
Leu Gly Ala Asn Gly Lys Gly Leu Met Leu Asn Val Thr Asp Pro Ala
      50      55      60
Ser Ile Glu Ser Val Leu Glu Lys Ile Arg Ala Glu Phe Gly Glu Val
      65      70      75      80
Asp Ile Leu Val Asn Asn Ala Gly Ile Thr Arg Asp Asn Leu Leu Met
      85      90      95
Arg Met Lys Asp Glu Glu Trp Asn Asp Ile Ile Glu Thr Asn Leu Ser
      100      105      110
Ser Val Phe Arg Leu Ser Lys Ala Val Met Arg Ala Met Met Lys Lys
      115      120      125
Arg His Gly Arg Ile Ile Thr Ile Gly Ser Val Val Gly Thr Met Gly
      130      135      140
Asn Gly Gly Gln Ala Asn Tyr Ala Ala Ala Lys Ala Gly Leu Ile Gly
      145      150      155      160
Phe Ser Lys Ser Leu Ala Arg Glu Val Ala Ser Arg Gly Ile Thr Val
      165      170      175
Asn Val Val Ala Pro Gly Phe Ile Glu Thr Asp Met Thr Arg Ala Leu
      180      185      190
Ser Asp Asp Gln Arg Ala Gly Ile Leu Ala Gln Val Pro Ala Gly Arg
      195      200      205
Leu Gly Gly Ala Gln Glu Ile Ala Asn Ala Val Ala Phe Leu Ala Ser
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Met Tyr Met Val

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<210> 2

<211> 735

<212> DNA

<213> Escherichia coli

<220>

<221> CDS

<222> (1)...(732)

<400> 2

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att ggc cgc gca att gct gaa acg ctc gca gcc cgt ggc gcg aaa gtt	96
Ile Gly Arg Ala Ile Ala Glu Thr Leu Ala Ala Arg Gly Ala Lys Val	
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att ggc act gcg acc agt gaa aat ggc gct cag gcg atc agt gat tat	144
Ile Gly Thr Ala Thr Ser Glu Asn Gly Ala Gln Ala Ile Ser Asp Tyr	
35 40 45	
tta ggt gcc aac ggc aaa ggt ctg atg ttg aat gtg acc gac ccg gca	192
Leu Gly Ala Asn Gly Lys Gly Leu Met Leu Asn Val Thr Asp Pro Ala	
50 55 60	
tct atc gaa tct gtt ctg gaa aaa att cgc gca gaa ttt ggt gaa gtg	240
Ser Ile Glu Ser Val Leu Glu Lys Ile Arg Ala Glu Phe Gly Glu Val	
65 70 75 80	
gat atc ctg gtc aat aat gcc ggt atc act cgt gat aac ctg tta atg	288
Asp Ile Leu Val Asn Asn Ala Gly Ile Thr Arg Asp Asn Leu Leu Met	
85 90 95	
cga atg aaa gat gaa gag tgg aac gat att atc gaa acc aac ctt tca	336
Arg Met Lys Asp Glu Glu Trp Asn Asp Ile Ile Glu Thr Asn Leu Ser	
100 105 110	
tct gtt ttc cgt ctg tca aaa gcg gta atg cgc gct atg atg aaa aag	384
Ser Val Phe Arg Leu Ser Lys Ala Val Met Arg Ala Met Met Lys Lys	
115 120 125	
cgt cat ggt cgt att atc act atc ggt tct gtg gtt ggt acc atg gga	432
Arg His Gly Arg Ile Ile Thr Ile Gly Ser Val Val Gly Thr Met Gly	
130 135 140	
aat ggc ggt cag gcc aac tac gct gcg gcg aaa gcg gcc ttg atc ggc	480
Asn Gly Gly Gln Ala Asn Tyr Ala Ala Ala Lys Ala Gly Leu Ile Gly	
145 150 155 160	
ttc agt aaa tca ctg gcg cgc gaa gtt gcg tca cgc ggt att act gta	528
Phe Ser Lys Ser Leu Ala Arg Glu Val Ala Ser Arg Gly Ile Thr Val	
165 170 175	
aac gtt gtt gct ccg gcc ttt att gaa acg gac atg aca cgt gcg ctg	576
Asn Val Val Ala Pro Gly Phe Ile Glu Thr Asp Met Thr Arg Ala Leu	
180 185 190	
agc gat gac cag cgt gcg ggt atc ctg gcg cag gtt cct gcg ggt cgc	624
Ser Asp Asp Gln Arg Ala Gly Ile Leu Ala Gln Val Pro Ala Gly Arg	
195 200 205	
ctc ggc ggc gca cag gaa atc gcc aac gcg gtt gca ttc ctg gca tcc	672
Leu Gly Gly Ala Gln Glu Ile Ala Asn Ala Val Ala Phe Leu Ala Ser	
210 215 220	

gac gaa gca gct tac atc acg ggt gaa act ttg cat gtg aac ggc ggg 720
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 Met Tyr Met Val

735

<210> 3
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 <213> Artificial Sequence

<220>
 <223> Artificially synthesized primer sequence

<400> 3
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36

<210> 4
 <211> 32
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Artificially synthesized primer sequence

<400> 4
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<210> 5
 <211> 248
 <212> PRT
 <213> Bacillus subtilis

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 35 40 45
 Asp Glu Ile Lys Ser Met Gly Arg Lys Ala Ile Ala Val Lys Ala Asp
 50 55 60
 Val Ser Asn Pro Glu Asp Val Gln Asn Met Ile Lys Glu Thr Leu Ser
 65 70 75 80
 Val Phe Ser Thr Ile Asp Ile Leu Val Asn Asn Ala Gly Ile Thr Arg
 85 90 95
 Asp Asn Leu Ile Met Arg Met Lys Glu Asp Glu Trp Asp Asp Val Ile
 100 105 110
 Asn Ile Asn Leu Lys Gly Val Phe Asn Cys Thr Lys Ala Val Thr Arg
 115 120 125
 Gln Met Met Lys Gln Arg Ser Gly Arg Ile Ile Asn Val Ser Ser Ile
 130 135 140
 Val Gly Val Ser Gly Asn Pro Gly Gln Ala Asn Tyr Val Ala Ala Lys
 145 150 155 160
 Ala Gly Val Ile Gly Leu Thr Lys Ser Ser Ala Lys Glu Leu Ala Ser
 165 170 175
 Arg Asn Ile Thr Val Asn Ala Ile Ala Pro Gly Phe Ile Ser Thr Asp
 180 185 190

Met Thr Asp Lys Leu Ala Lys Asp Val Gln Asp Glu Met Leu Lys Gln
 195 200 205
 Ile Pro Leu Ala Arg Phe Gly Glu Pro Ser Asp Val Ser Ser Val Val
 210 215 220
 Thr Phe Leu Ala Ser Glu Gly Ala Arg Tyr Met Thr Gly Gln Thr Leu
 225 230 235 240
 His Ile Asp Gly Gly Met Val Met
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<210> 6
 <211> 747
 <212> DNA
 <213> Bacillus subtilis

<220>
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 <222> (1)...(744)

<400> 6
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 gga atc ggc cgc tca atc gcc ctt gct ctg gca aaa agc gga gca aat 96
 Gly Ile Gly Arg Ser Ile Ala Leu Ala Lys Ser Gly Ala Asn
 20 25 30
 gtt gtc gtg aac tac tcc ggc aat gaa gcg aaa gca aat gaa gtg gta 144
 Val Val Val Asn Tyr Ser Gly Asn Glu Ala Lys Ala Asn Glu Val Val
 35 40 45
 gat gaa atc aaa tca atg ggc aga aaa gca att gct gta aaa gcg gat 192
 Asp Glu Ile Lys Ser Met Gly Arg Lys Ala Ile Ala Val Lys Ala Asp
 50 55 60
 gta tca aat ccc gaa gat gta caa aac atg ata aaa gaa aca ttg tct 240
 Val Ser Asn Pro Glu Asp Val Gln Asn Met Ile Lys Glu Thr Leu Ser
 65 70 75 80
 gtt ttt tct acg att gac att ctg gtt aat aat gcg gga att aca aga 288
 Val Phe Ser Thr Ile Asp Ile Leu Val Asn Ala Gly Ile Thr Arg
 85 90 95
 gac aat ctc atc atg aga atg aaa gaa gac gaa tgg gat gac gtc att 336
 Asp Asn Leu Ile Met Arg Met Lys Glu Asp Glu Trp Asp Asp Val Ile
 100 105 110
 aac att aac ctg aag ggt gtt ttc aac tgc aca aaa gct gtt aca aga 384
 Asn Ile Asn Leu Lys Gly Val Phe Asn Cys Thr Lys Ala Val Thr Arg
 115 120 125
 caa atg atg aaa cag cgt tca ggc cgc att att aac gta tcg tct atc 432
 Gln Met Met Lys Gln Arg Ser Gly Arg Ile Ile Asn Val Ser Ser Ile
 130 135 140
 gtc ggc gtc agc gga aac cct gga caa gcc aac tac gtg gct gca aaa 480
 Val Gly Val Ser Gly Asn Pro Gly Gln Ala Asn Tyr Val Ala Ala Lys
 145 150 155 160
 gcc ggc gtc atc ggt tta acc aaa tct tct gct aaa gag ctc gcc agc 528
 Ala Gly Val Ile Gly Leu Thr Lys Ser Ser Ala Lys Glu Leu Ala Ser
 165 170 175

cga aat att acg gta aac gca ata gcg cca gga ttt atc tca act gat	576
Arg Asn Ile Thr Val Asn Ala Ile Ala Pro Gly Phe Ile Ser Thr Asp	
180 185 190	
atg aca gat aaa ctt gca aaa gac gtt caa gac gaa atg ctg aaa caa	624
Met Thr Asp Lys Leu Ala Lys Asp Val Gln Asp Glu Met Leu Lys Gln	
195 200 205	
att ccg ctc gcg cgc ttt ggt gaa cct agc gat gtc agc agt gtt gtc	672
Ile Pro Leu Ala Arg Phe Gly Glu Pro Ser Asp Val Ser Ser Val Val	
210 215 220	
acg ttc cta gct tca gag gga gct cgt tat atg aca ggc caa acg ctt	720
Thr Phe Leu Ala Ser Glu Gly Ala Arg Tyr Met Thr Gly Gln Thr Leu	
225 230 235 240	
cat att gac ggc gga atg gtg atg taa	747
His Ile Asp Gly Gly Met Val Met	
245	

<210> 7
 <211> 33
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Artificially synthesized primer sequence

<400> 7 33
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<210> 8
 <211> 34
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Artificially synthesized primer sequence

<400> 8 34
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<210> 9
 <211> 246
 <212> PRT
 <213> Ralstonia eutropha

<400> 9
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 Gly Cys Gly Pro Asn Ser Pro Arg Arg Glu Lys Trp Leu Glu Gln Gln
 35 40 45
 Lys Ala Leu Gly Phe Asp Phe Ile Ala Ser Glu Gly Asn Val Ala Asp
 50 55 60
 Trp Asp Ser Thr Lys Thr Ala Phe Asp Lys Val Lys Ser Glu Val Gly
 65 70 75 80

Glu Val Asp Val Leu Ile Asn Asn Ala Gly Ile Thr Arg Asp Val Val
 85 90 95
 Phe Arg Lys Met Thr Arg Ala Asp Trp Asp Ala Val Ile Asp Thr Asn
 100 105 110
 Leu Thr Ser Leu Phe Asn Val Thr Lys Gln Val Ile Asp Gly Met Ala
 115 120 125
 Asp Arg Gly Trp Gly Arg Ile Val Asn Ile Ser Ser Val Asn Gly Gln
 130 135 140
 Lys Gly Gln Phe Gly Gln Thr Asn Tyr Ser Thr Ala Lys Ala Gly Leu
 145 150 155 160
 His Gly Phe Thr Met Ala Leu Ala Gln Glu Val Ala Thr Lys Gly Val
 165 170 175
 Thr Val Asn Thr Val Ser Pro Gly Tyr Ile Ala Thr Asp Met Val Lys
 180 185 190
 Ala Ile Arg Gln Asp Val Leu Asp Lys Ile Val Ala Thr Ile Pro Val
 195 200 205
 Lys Arg Leu Gly Leu Pro Glu Glu Ile Ala Ser Ile Cys Ala Trp Leu
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 225 230 235 240
 Gly Gly Leu His Met Gly
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<210> 10
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 <212> DNA
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<220>
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 Thr Ala Ile Cys Gln Arg Leu Ala Lys Asp Gly Phe Arg Val Val Ala
 20 25 30
 ggt tgc ggc ccc aac tcg ccg cgc cgc gaa aag tgg ctg gag cag cag 144
 Gly Cys Gly Pro Asn Ser Pro Arg Arg Glu Lys Trp Leu Glu Gln Gln
 35 40 45
 aag gcc ctg ggc ttc gat ttc att gcc tcg gaa ggc aat gtg gct gac 192
 Lys Ala Leu Gly Phe Asp Phe Ile Ala Ser Glu Gly Asn Val Ala Asp
 50 55 60
 tgg gac tcg acc aag acc gca ttc gac aag gtc aag tcc gag gtc ggc 240
 Trp Asp Ser Thr Lys Thr Ala Phe Asp Lys Val Lys Ser Glu Val Gly
 65 70 75 80
 gag gtt gat gtg ctg atc aac aac gcc ggt atc acc cgc gac gtg gtg 288
 Glu Val Asp Val Leu Ile Asn Asn Ala Gly Ile Thr Arg Asp Val Val
 85 90 95
 ttc cgc aag atg acc cgc gcc gac tgg gat gcg gtg atc gac acc aac 336
 Phe Arg Lys Met Thr Arg Ala Asp Trp Asp Ala Val Ile Asp Thr Asn
 100 105 110

ctg acc tcg ctg ttc aac gtc acc aag cag gtg atc gac ggc atg gcc	384
Leu Thr Ser Leu Phe Asn Val Thr Lys Gln Val Ile Asp Gly Met Ala	
115 120 125	
gac cgt ggc tgg ggc cgc atc gtc aac atc tcg tcg gtg aac ggg cag	432
Asp Arg Gly Trp Gly Arg Ile Val Asn Ile Ser Ser Val Asn Gly Gln	
130 135 140	
aag ggc cag ttc ggc cag acc aac tac tcc acc gcc aag gcc ggc ctg	480
Lys Gly Gln Phe Gly Gln Thr Asn Tyr Ser Thr Ala Lys Ala Gly Leu	
145 150 155 160	
cat ggc ttc acc atg gca ctg gcg cag gaa gtg gcg acc aag ggc gtg	528
His Gly Phe Thr Met Ala Leu Ala Gln Glu Val Ala Thr Lys Gly Val	
165 170 175	
acc gtc aac acg gtc tct ccg ggc tat atc gcc acc gac atg gtc aag	576
Thr Val Asn Thr Val Ser Pro Gly Tyr Ile Ala Thr Asp Met Val Lys	
180 185 190	
gcg atc cgc cag gac gtg ctc gac aag atc gtc gcg acg atc ccg gtc	624
Ala Ile Arg Gln Asp Val Leu Asp Lys Ile Val Ala Thr Ile Pro Val	
195 200 205	
aag cgc ctg ggc ctg ccg gaa gag atc gcc tcg atc tgc gcc tgg ttg	672
Lys Arg Leu Gly Leu Pro Glu Glu Ile Ala Ser Ile Cys Ala Trp Leu	
210 215 220	
tcg tcg gag gag tcc ggt ttc tcg acc ggc gcc gac ttc tcg ctc aac	720
Ser Ser Glu Glu Ser Gly Phe Ser Thr Gly Ala Asp Phe Ser Leu Asn	
225 230 235 240	
ggc ggc ctg cat atg ggc taa	741
Gly Gly Leu His Met Gly	
245	

<210> 11
 <211> 30
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Artificially synthesized primer sequence

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<210> 12
 <211> 35
 <212> DNA
 <213> Artificial Sequence

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<400> 12	
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<210> 13
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<213> Artificial Sequence
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 <213> Artificial Sequence
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 1 5 10
 gga gct gct tca ggg ctc gga aag gcg atg gcc att cgc ttc ggc aag 98
 Gly Ala Ala Ser Gly Leu Gly Lys Ala Met Ala Ile Arg Phe Gly Lys
 15 20 25
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 Glu Gln Ala Lys Val Ile Asn Tyr Tyr Ser Asn Lys Gln Asp Pro
 30 35 40 45

aac gag gta aaa gaa gag gtc atc aag gcg ggc ggt gaa gct gtt gtc 194
 Asn Glu Val Lys Glu Glu Val Ile Lys Ala Gly Gly Glu Ala Val Val
 50 55 60
 gtc caa gga gat gtc acg aaa gag gaa gat gta aaa aat atc gtg caa 242
 Val Gln Gly Asp Val Thr Lys Glu Glu Asp Val Lys Asn Ile Val Gln
 65 70 75
 acg gca att aag gag ttc ggc aca ctc gat att atg att aat aat gcc 290
 Thr Ala Ile Lys Glu Phe Gly Thr Leu Asp Ile Met Ile Asn Asn Ala
 80 85 90
 ggt ctt gaa aat cct gtg cca tct cac gaa atg ccg ctc aag gat tgg 338
 Gly Leu Glu Asn Pro Val Pro Ser His Glu Met Pro Leu Lys Asp Trp
 95 100 105
 gat aaa gtc atc ggc acg aac tta acg ggt gcc ttt tta gga agc cgt 386
 Asp Lys Val Ile Gly Thr Asn Leu Thr Gly Ala Phe Leu Gly Ser Arg
 110 115 120 125
 gaa gcg att aaa tat ttc gta gaa aac gat atc aag gga aat gtc att 434
 Glu Ala Ile Lys Tyr Phe Val Glu Asn Asp Ile Lys Gly Asn Val Ile
 130 135 140
 aac atg tcc agt gtg cac gaa gtg att cct tgg ccg tta ttt gtc cac 482
 Asn Met Ser Ser Val His Glu Val Ile Pro Trp Pro Leu Phe Val His
 145 150 155
 tat gcg gca agt aaa ggc ggg ata aag ctg atg aca gaa aca tta gcg 530
 Tyr Ala Ala Ser Lys Gly Gly Ile Lys Leu Met Thr Glu Thr Leu Ala
 160 165 170
 ttg gaa tac gcg ccg aag ggc att cgc gtc aat aat att ggg cca ggt 578
 Leu Glu Tyr Ala Pro Lys Gly Ile Arg Val Asn Asn Ile Gly Pro Gly
 175 180 185
 gcg atc aac acg cca atc aat gct gaa aaa ttc gct gac cct aaa cag 626
 Ala Ile Asn Thr Pro Ile Asn Ala Glu Lys Phe Ala Asp Pro Lys Gln
 190 195 200 205
 aaa gct gat gta gaa agc atg att cca atg gga tat atc ggc gaa ccg 674
 Lys Ala Asp Val Glu Ser Met Ile Pro Met Gly Tyr Ile Gly Glu Pro
 210 215 220
 gag gag atc gcc gca gta gca gcc tgg ctt gct tcg aag gaa gcc agc 722
 Glu Glu Ile Ala Ala Val Ala Ala Trp Leu Ala Ser Lys Glu Ala Ser
 225 230 235
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 Tyr Val Thr Gly Ile Thr Leu Phe Ala Asp Gly Gly Met Thr Gln Tyr
 240 245 250
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 Pro Ser Phe Gln Ala Gly Arg Gly
 255 260

<210> 18
 <211> 261
 <212> PRT
 <213> Bacillus subtilis

<400> 18
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 35 40 45
 Lys Glu Glu Val Ile Lys Ala Gly Gly Glu Ala Val Val Val Gln Gly
 50 55 60
 Asp Val Thr Lys Glu Glu Asp Val Lys Asn Ile Val Gln Thr Ala Ile
 65 70 75 80
 Lys Glu Phe Gly Thr Leu Asp Ile Met Ile Asn Asn Ala Gly Leu Glu
 85 90 95
 Asn Pro Val Pro Ser His Glu Met Pro Leu Lys Asp Trp Asp Lys Val
 100 105 110
 Ile Gly Thr Asn Leu Thr Gly Ala Phe Leu Gly Ser Arg Glu Ala Ile
 115 120 125
 Lys Tyr Phe Val Glu Asn Asp Ile Lys Gly Asn Val Ile Asn Met Ser
 130 135 140
 Ser Val His Glu Val Ile Pro Trp Pro Leu Phe Val His Tyr Ala Ala
 145 150 155 160
 Ser Lys Gly Gly Ile Lys Leu Met Thr Glu Thr Leu Ala Leu Glu Tyr
 165 170 175
 Ala Pro Lys Gly Ile Arg Val Asn Asn Ile Gly Pro Gly Ala Ile Asn
 180 185 190
 Thr Pro Ile Asn Ala Glu Lys Phe Ala Asp Pro Lys Gln Lys Ala Asp
 195 200 205
 Val Glu Ser Met Ile Pro Met Gly Tyr Ile Gly Glu Pro Glu Glu Ile
 210 215 220
 Ala Ala Val Ala Ala Trp Leu Ala Ser Lys Glu Ala Ser Tyr Val Thr
 225 230 235 240
 Gly Ile Thr Leu Phe Ala Asp Gly Gly Met Thr Gln Tyr Pro Ser Phe
 245 250 255
 Gln Ala Gly Arg Gly
 260

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